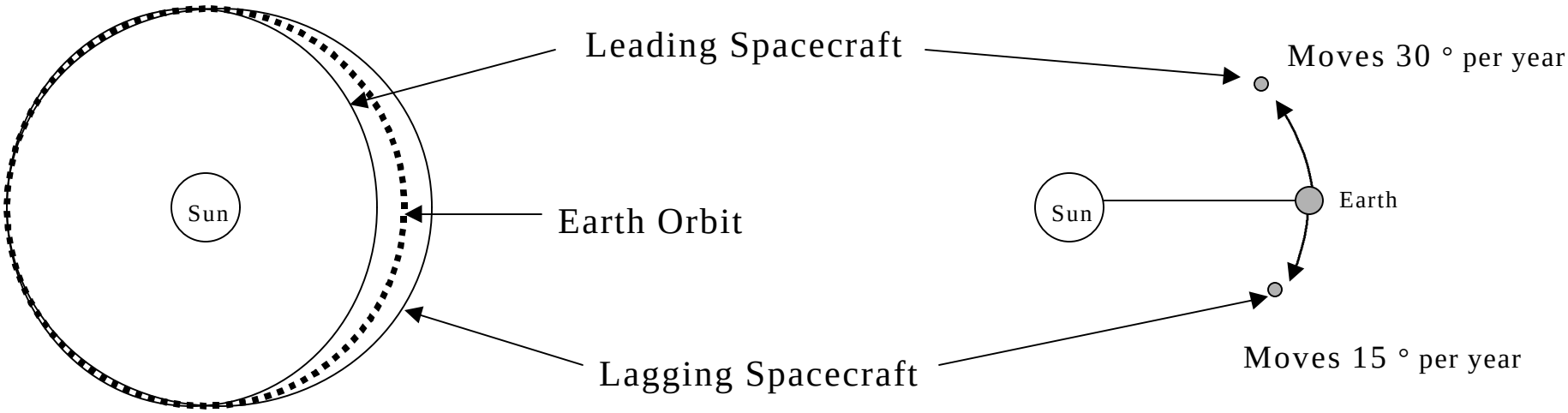
STEREO System Description

A. Santo

Mission Design

• One spacecraft orbit less than 1 AU; other orbit greater than 1 AU

• As viewed in a fixed Sun-Earth frame; each spacecraft slowly moves away from Earth



Launch Vehicle Selection

- Launch vehicle trade study
  - Single launch lowers launch vehicle cost
    - Shuttle
    - Delta II
  - Dual launch simplifies spacecraft design by deleting orbit-adjust requirement
    - Taurus
    - Athena II
- Starting baseline is dual launches using an ELV with the leading spacecraft launched 3 months after the launch of the lagging spacecraft
- Both 2002 and 2004 launch dates will be studied

STEREO Overview

- Spacecraft
  - Both spacecraft are identical
  - 3-axis controlled
  - Propulsion for momentum management, no orbit-maintenance requirement
  - Single-string with 2 year primary mission
  - Parts/components designed for 2 year mission duration
  - Consumables for 5 year mission duration
- Operations
  - Decoupled spacecraft/ instrument operations
  - Daily contacts (7 per week) using 34-m DSN antennas
  - Space weather downlink using HGA when not in 34-m contact

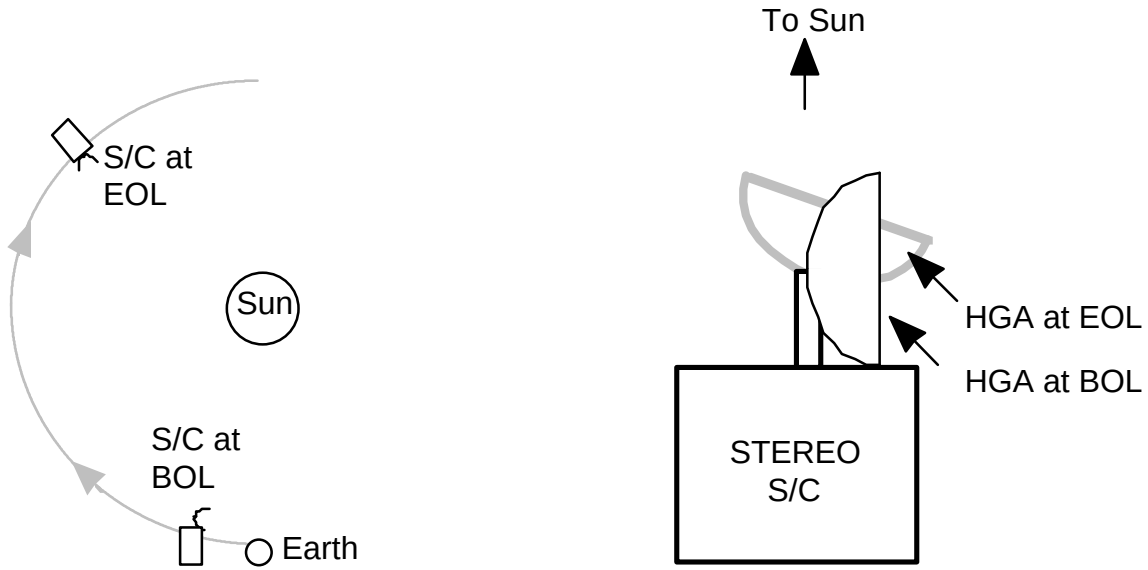
Space Weather Monitoring

- Whenever not in contact with 34-m DSN assets, transmit a low-rate (" 500 bps) science stream that is available to space weather enthusiasts
- All on-board science data processing to be provided by the instruments
- No knowledge of the data content is required by the spacecraft
- A description of the intended ground assets and required downlink rate will be provided by GSFC
- A group outside of APL will evaluate the space weather data and page APL Mission Operations if an urgent, unplanned DSN contact needs to be supported

Payload Description

Instrument	Heritage	Measurement
Solar Coronal Imaging Package (SCIP)	Coronograph is similar to the SPARTAN 201 coronograph with offset occulter Coronal Doppler Imager based on simplified version of TRACE and EIT	White light imager w/CCD detectors EUV Doppler imager
Energetic Particle Detector (EPD)	ACE	Absolute intensity and energy spectra of energetic particles
Radio Burst Tracker (RBT)	Similar to WIND and GALILEO	Tracks solar radio disturbances
Magnetometer	Similar to GIOTTO, CLUSTER, MGS	Interplanetary magnetic fields
Solar Wind Plasma Analyzer (SWPA)	WIND	Proton and electron density
Heliospheric Imager (HI)	New design	Tracks the solar wind from the sun to the earth

Spacecraft Attitude



- Spacecraft attitude has the instrument boresight direction toward the Sun with the roll axis selected to point the HGA/MGA toward Earth
- HGA on single-axis gimbal to allow simultaneous data collection and downlink

Implementation Responsibilities

- APL
  - Provide spacecraft bus, instrument integration, mission design, mission operations, and navigation
  - Manage DSN interfaces
  - Manage spacecraft to instrument interfaces
- GSFC
  - Provide and operate instruments
  - Provide and operate science data center
  - Launch vehicle procurement

STEREO Drivers

- Cost
  - Technical approach with lowest cost uncertainty selected (TIMED rebuild -- single string)
  - Improvements on TIMED design discouraged -- changes only when necessary or when cost can be reduced
  - Innovations that can reduce cost are encouraged, i.e installing flight battery not before environmental test, but at launch site
- Technical
  - Maximize science data return
    - HGA size limited by fairing size, field-of-regard, and instrument FOV requirements
    - Power amplifier size drives power and thermal designs
  - Challenging jitter specification
  - Any technical requirement that is a significant cost driver is subject to negotiation

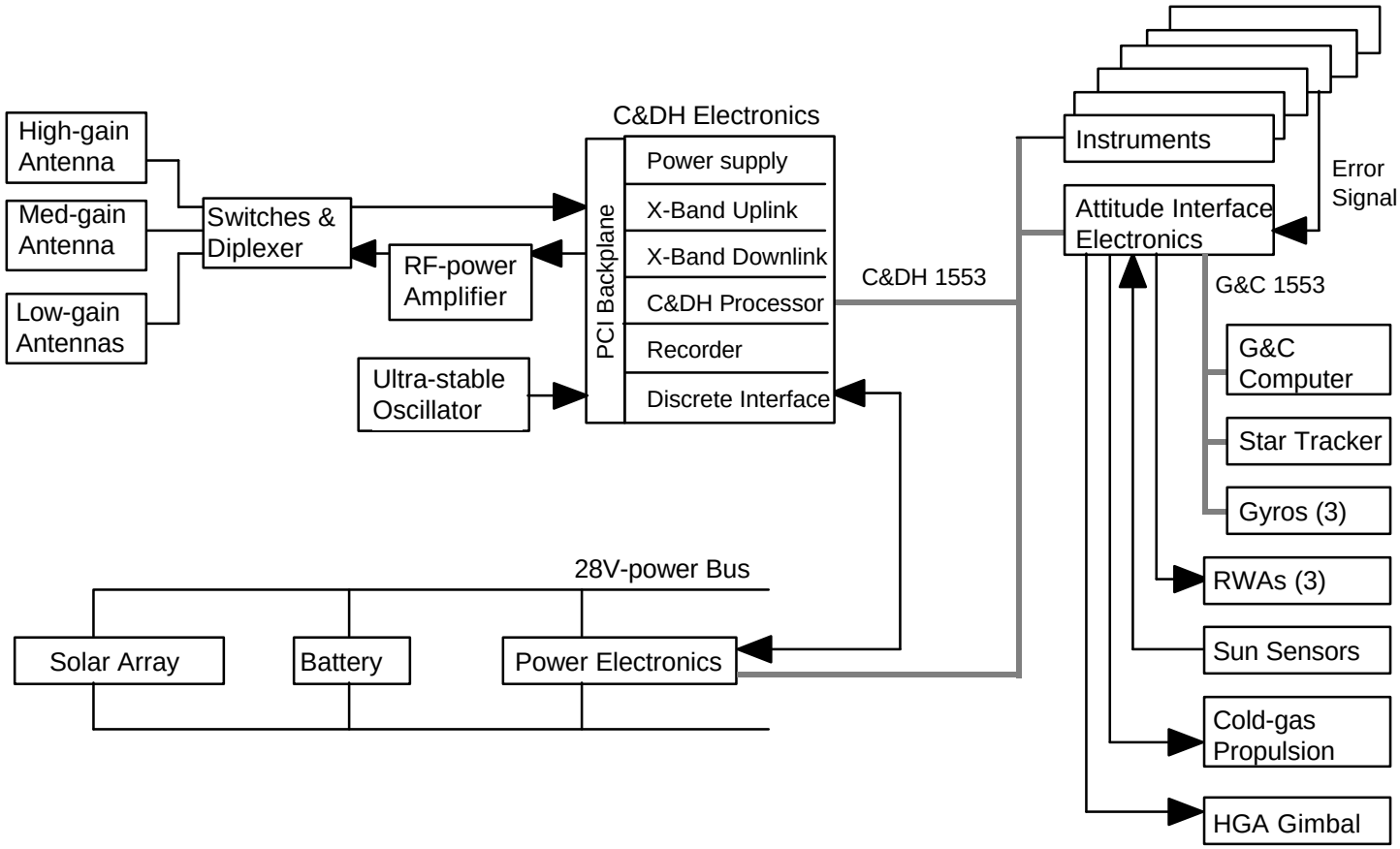
Changes to TIMED Design-1

- New Fault Protection Design
- Power
  - Smaller battery
  - Smaller, fixed silicon arrays
- Telecom
  - External X-band power amplifier
  - New antenna configuration including gimbaled HGA
  - Data for ground-based navigation to be supplied via telecom system
  - Addition of ultra-stable oscillator

Changes to TIMED Design-2

- G&C
  - Sun sensors supplied by subcontractor
  - Addition of propulsion system to dump momentum
  - Use of instrument data for fine pointing and jitter control
- C&DH
  - No GPS
  - Entire C&DH on unswitched power
  - Increased data storage
  - Multiple uplink/downlink rates
  - Support either 1/2 or 1/6 convolution coding on the downlink data
  - UT time maintenance via ultra-stable oscillator

Spacecraft Block Diagram



Power/Mass List

ITEM	Mass (kg)	Power (W)
Instruments w/booms	73.5	106.5
C&DH	8	25
Ultra-stable Oscillator	1	1
Power Amplifier w/ conv.	3	70
RF Coaxial cable	2	0
RF diplexer/switches	0.5	0
HGA	5	0
HGA Gimbal	3.5	0
MGA/LGA	1	0
Attitude Interface Elect.	4	7
G&C Computer	4.5	20
RWA (3)	9	18
Star Tracker	6.5	12.5
Gyro	5	25
Sun Sensor	1.5	1
Propulsion hardware	20	0
Propellant	12	0
Solar Array	15	0
Battery	10	3
Power Electronics	8	5
Structure	52.5	0
Harness	18	4.5
Blankets and Heaters	16	20
Totals	**279.5**	**318.5**
Capability	**350**	**400**
Margin	**20%**	**20%**

New Technology

- Subsystem leads to suggest and evaluate possible areas for new technology insertion . Areas where technology is changing rapidly should be discussed in subsystem design.
- New technology will only be considered to reduce cost or meet performance specification
- Candidate technologies include:
  - Advanced G&C computer (increase >4X in CPU and memory from TIMED)
  - Use of flaps or other method for momentum management
  - Phased-array downlink antenna
  - Lithium-ion battery
  - C&DH recorder features to allow selective data playback and autonomous recorder data deletion upon successful ground reception

Meeting Notes

- STEREO minutes on http://sd-www.jhuapl.edu/STEREO/Reports/
- Next meeting agenda
  - D. Rust — STEREO Science Objectives
  - A. Santo — Requirements Summary